

Vortman, Anatoly

From: art.fisher@patentdominion.com
Sent: Tuesday, September 27, 2005 4:32 PM
To: Vortman, Anatoly
Subject: Application - Ser. No. 10/666,189

Mr. Vortman,

I have attached a clean copy of the claims we have agreed per our conversation today.

The changes made include:

The language deletion we discussed in claim 62;
The language clarification (of "contact") in claim 71; and
The language additions we discussed for claim 76.

I also made a change to claim 80 that we did not discuss. I deleted the words "expelling the air" so that this language now parallels the language in claim 66. [Note; I actually attempted to make this change in the FAX I sent you this morning, but inadvertently made it to the "Currently Amended" version of the claim instead of the Proposal version of the claim.]

Finally, I have checked for proper antecedents for the dependent claims and I believe they were/are OK.

Please confirm receipt of this email by return email.

Thanks for your help.

Regards,

Art Fisher

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Application - 10/666,189 - Claims

53. A liquid cooling system for cooling heat-generating components in an electronic system having a self-contained heat exchange unit installable as a single unit within the electronic system and comprising:

an input cavity for receiving heated liquid and distributing the heated liquid to a dissipater;

a dissipater for receiving the heated liquid and cooling the liquid;

an output cavity for receiving the cooled liquid from the dissipater and transporting the cooled liquid to the system;

wherein the input cavity, the dissipater and the output cavity are disposed to form the self-contained heat exchange unit;

one or more heat transfer units coupled to the heat generating components for receiving cooled liquid from the heat exchange unit and generating heated liquid for transportation to the heat exchange unit; and

means for transporting cooled liquid from the heat exchange unit to the heat transfer units and for transporting heated liquid from the heat transfer units to the heat exchange unit.

54. A liquid cooling system as set forth in claims 53 wherein the heat transfer units and the heat exchange unit are deployed in a single unit installable as a single unit within the electronic system.

56. A liquid cooling system as set forth in claim 53 wherein the means for transporting includes a pump disposed in the heat exchange unit.

57. A liquid cooling system as set forth in claim 53 wherein the dissipater includes one or more liquid paths for transporting the liquid through the dissipater.

58. A liquid cooling system as set forth in claim 57 wherein said liquid paths include means for creating non-laminar flow of the liquid to enhance the transfer of heat from the liquid to the dissipater.
59. A liquid cooling system as set forth in claim 56 wherein the pump is disposed in the output cavity.
60. A liquid cooling system as set forth in claim 56, wherein the pump is a self-priming pump.
61. A liquid cooling system as set forth in claim 59 wherein the pump is disposed at the lowest possible point in the heat exchange unit.
62. A liquid cooling system as set forth in claim 56 wherein the pump includes an impeller, the heat exchange unit further comprising:
- a motor coupled to the heat exchange unit; and
- a shaft coupling the motor to the impeller means, the motor operating the impeller through the shaft.
63. A liquid cooling system as set forth in claim 62 wherein the motor is disposed on top of the heat exchange unit and away from possible contact with the liquid.
64. A liquid cooling system as set forth in claim 62 wherein the shaft is disposed through the liquid in the dissipater.
65. A liquid cooling system as set forth in claim 64 wherein no seal is necessary for the impeller.
66. A liquid cooling system as set forth in claim 53 wherein the heat exchange unit further comprises one or more fans disposed to direct air through the heat exchange unit and out of the electronic system housing.
67. The liquid cooling system as set forth in claim 66 wherein the dissipater includes fins for dissipating heat from the liquid and disposed so as to create a non-laminar flow of the air from the fans.

69. A liquid cooling system having a self-contained heat exchanger unit installable as a single unit within a system with one or more heat-generating components and having one or more heat transfer units, the liquid cooling system comprising:

an input cavity for receiving heated liquid and distributing the heated liquid to a dissipater;

a dissipater for receiving the heated liquid and cooling the liquid;

an output cavity for receiving the cooled liquid from the dissipater and transporting the cooled liquid to the system;

wherein the input cavity, the dissipater and the output cavity are disposed to form the self-contained heat exchange unit;

a heat transfer unit housing for coupling to heat-generating components;

an inlet to the heat transfer unit housing;

an outlet from the heat transfer unit housing positioned above the inlet;

means for transporting liquid coupled to the inlet and the outlet; and

wherein cooled liquid from the self-contained heat exchange unit enters the heat transfer unit housing at the inlet and heated liquid exits the heat transfer unit housing at the outlet.

70. The liquid cooling system in claim 69 for cooling heat generating components in an electronic system.

71. The liquid cooling system of claim 70 wherein the heat transfer units further comprise:

a contact side coupled to the housing for forming a cavity for conveying liquid and thermally coupled to one or more heat-generating components, the contact side capable of transporting heat from the heat generating components to the liquid thereby producing heated liquid which rises in the cavity.

72. The liquid cooling system in claim 53 wherein the input cavity is positioned above the dissipater and the output cavity is positioned below the dissipater.

73. A liquid cooling system as set forth in claim 53 wherein the liquid coolant is a propylene glycol base.

76. A method of cooling heat generating components in an electronic system having a self-contained heat exchange unit installable as a single unit within the electronic system, the self-contained heat exchange unit including an input cavity for receiving heated liquid and distributing the heated liquid to a dissipater which cools the heated liquid and an output cavity for receiving the cooled liquid from the dissipater and transporting the cooled liquid to the electronic system, and wherein the input cavity, the dissipater and the output cavity are disposed to form the self-contained heat exchange unit, and further having one or more heat transfer units coupled to the heat generating components for receiving cooled liquid from the heat exchange unit and generating heated liquid for transportation to the heat exchange unit and means for transporting cooled liquid from the heat exchange unit to the heat transfer units and for transporting heated liquid from the heat transfer units to the heat exchange unit; the method comprising:

a step for receiving heated liquid from the heat transfer units at the self-contained heat exchange unit;

a step for cooling the liquid within the self-contained heat exchange unit for transportation to the heat transfer units;

a step for transporting the cooled liquid to the heat transfer units by said means for transporting;

a step for receiving cooled liquid from the self-contained heat exchange unit at the heat transfer units;
and

a step for heating the liquid within the heat transfer units by transferring heat from the heat-generating components to the liquid for transportation to the self-contained heat exchange unit.

78. A method of cooling as set forth in claim 76, the method further comprising the steps of:

receiving heated liquid at an input cavity of the self-contained heat exchange unit and distributing the heated liquid to a dissipater in the self-contained heat exchange unit;

cooling the liquid in the dissipater; and

receiving the cooled liquid from the dissipater at an output cavity in the self-contained heat exchange unit for directing the cooled liquid to the system.

80. The method of claim 76 further comprising the step of directing air flow through the heat exchange unit and out of the electronic system to maintain cooler temperatures inside the electronic system housing.

82. A method of cooling as set forth in claim 76, comprising the steps of:

performing convective circulation in one or more of the heat transfer units by positioning an outlet for heated liquid from the heat transfer units above an inlet of the heat transfer units which receives cooled liquid, the liquid rising in response to the transfer of heat from the heat generating components to the liquid in the heat transfer units.

84. A method of cooling as set forth in claim 76 comprising the additional steps of performing convective circulation by:

positioning the input cavity above the dissipater; and

positioning the output cavity below the dissipater.

86. A method of cooling as set forth in claim 76, the method further comprising the steps of:

performing forced circulation of the liquid in the liquid cooling system by a pump; and

performing convective circulation of the liquid in the liquid cooling system by disposing inlets and outlets for cooler liquid below inlets and outlets for heated liquid.

87. The method in claim 86 further including the step of dissipating heat generated by the heat generating components in response to the forced circulation and convective circulation.

88. The method in claim 86 wherein the heat generating components are cooled after power is shut down in the system.

89. The method in claim 86 for saving power consumed in the system.

90. A method of cooling as set forth in claim 76 further comprising the step of using propylene glycol as the base for the liquid coolant.

92. A motherboard further comprising the liquid cooling system of any one of those in claims 53, 56 or 69.

93. A computer further comprising the liquid cooling system of any one of those in claims 53, 56 or 69.

94. A telecommunications system further comprising the liquid cooling system of any one of those in claims 53, 56 or 69.

95. A cellular telephone further comprising the liquid cooling system of any one of those in claims 53, 56 or 69.

96. A device including a processor further comprising the liquid cooling system of any one of those in claims 53, 56 or 69.

97. An optical device further comprising the liquid cooling system of any one of those in claims 53, 56 or 69.